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PATENT COOPERATION TREAT

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 30 May 2001 (30.05.01)	
International application No. PCT/NO00/00270	**Applicant's or agent's file reference** P1043PC00
International filing date (day/month/year) 18 August 2000 (18.08.00)	**Priority date** (day/month/year) 20 August 1999 (20.08.99)
Applicant HEGGDAL, Ole, A.	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

20 March 2001 (20.03.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Claudio Borton
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
P1043PC00/AT		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NO00/00270	18.08.2000	20.08.1999
International Patent Classification (IPC) or national classification and IPC7		
F16L 9/19, F16L 11/12		
Applicant		
Kvaerner Oilfield Products AS et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
20.03.2001	29.10.2001
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Telex 17978 PATOREG-S
Authorized officer Axel Lindhult / MRo Telephone No. 08-782 25 00	

Form PCT/IPEA/409 (cover sheet) (January 1998)

INTERNATIONAL PRE[redacted]ARY EXAMINATION REPORT

I[redacted]ational application No.
PC[redacted]/NO00/00270

I. Basis of the report

1. With regard to the **elements** of the international application:*

☐ the international application as originally filed

☒ the description:
pages 1-9 , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____

☒ the claims:
pages _____ , as originally filed
pages _____ , as amended (together with any statement) under article 19
pages _____ , filed with the demand
pages 11-14 , filed with the letter of 24.08.2001

☒ the drawings:
pages 1-5 , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____

☐ the sequence listing part of the description:
pages _____ , as originally filed
pages _____ , filed with the demand
pages _____ , filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language English which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☒ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheet/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item I and annexed to this report.*

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/NO00/00270

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-19	YES
	Claims		NO
Inventive step (IS)	Claims	5-8,10-14	YES
	Claims	1-4,9,15-19	NO
Industrial applicability (IA)	Claims	1-19	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

D1: SE 353783 B
D2: NO 174940 C
D3: US 3548158 A
D4: US 4194536 A
D5: US 4798230 A
D6: US 4288653 A

The invention relates to a production/injection line assembly for subsea transportation of hydrocarbons, comprising a production/injection tube and heating means for active heating of the tube. The invention also relates to a method for supplying heat to said line and a method for manufacturing the line.

The object of the invention is to provide insulation means to control the heat transfer from the heating means in toward the production/injection tube.

The cited publications D2 and D4 are the most relevant documents.

Document D2 discloses a cable, where a core tube (5), for transport of chemicals for injection in a well, is surrounded by prefabricated, long spacers (page 7, line 26) and control cables for the transfer of hydraulic fluid, electrical and optical signals, electric power, etc. The spacers comprise inner channel members (6) having longitudinal channels (21), which inner channel members are laid around the core tube in a continuous production line with the channels facing outwardly.

... /...

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V.

The spacers also comprise outer channel members (9) having longitudinal channels (22), which outer channel members are laid flush with the channels of the inner channel members in a continuous line. The control cables are laid in the longitudinal channels of the inner channel members and are enclosed by the outer channel members, wherein the channel members accommodate said control cables.

Document D4 (see fig. 8) discloses a composite tubing, comprising a fluid conveyance line (1) and heating means (9) for active heating of the line. Continuous thermal insulation means (14, see column 6, line 29) are arranged along the conveyance line to control the heat transfer from the heating means in towards the line.

Consequently, the subject matter of claim 1 differs from the device described in document D2 principally in that the core tube is "...a production/injection tube...", that the channel members consist of "...thermal insulation means..." and that "...heating means..." are laid in the longitudinal channels. However, since these features are already known from document D4, it would be obvious to a person skilled in the art to apply this knowledge to the device according to document D2. The subject matter of claim 1, therefore, does not appear to involve an inventive step.

The features of the characterising portions of claims 2-4 and 9 are also known from document D4. Therefore, the subject matter of these claims is not considered to involve an inventive step.

It must be obvious to a person skilled in the art to use waste fluid or cooling fluid such as waste water from a process on an installation, in the heating pipes according to document D4. Therefore, the subject matter of claims 15 and 16 does not appear to involve an inventive step.

The method according to claims 17-19 differs from the subject matter of document D2 in that the core tube is "...a production/injection tube..." for "...transportation of hydrocarbons..." and "...at least a portion of the channel members..." is an "...insulation means...". However, to

... /...

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V.

manufacture the outer channel members (9) of a heat insulating material is in view of document D4 a choice that a person skilled in the art would undertake to achieve a suitable production line in correspondence to the actual needs without being inventive. The subject matter of claims 17-19, therefore, does not appear to involve an inventive step.

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claim 16 shall refer to claim 15.
The expression "...the insulation and heat conducting means..." in claim 18 should be replaced by "the insulation means and heat conducting means" ("heat conducting means" have not been mentioned in claim 17).

New Patent Claims

Our ref.: P1043PC00

Appl. No.: PCT/NO00/00270

1.

A production/injection line assembly for subsea transportation of hydrocarbons, comprising a production/injection tube (1, 11, 30) and heating means (4, 18, 26, 32) for active heating of the tube (1, 11, 30), and along the production/injection line, over at least 100 m, continuous thermal insulation means (11, 12, 13, 32, 33) to control the heat transfer from the heating means (4, 18, 26, 32) in towards the production/injection tube (1, 11, 30), characterized in that the insulation means comprise prefabricated inner channel members (5, 12, 32) having longitudinal channels, which inner channel members are laid around the production/injection tube (1, 11, 30) in a continuous production line with the channels of the inner channel members facing outwardly, and prefabricated outer channel members (7, 13, 32) having longitudinal channels, which outer channel members are laid flush with the channels of the inner channel members in a continuous production line, and that heating means (4, 18, 26, 32) are laid in the longitudinal channels of the inner channel members and enclosed by the outer channel members, wherein the channel members (5, 7, 12, 13, 31, 32) accommodate said heating means (4, 18, 26, 32).

2.

The assembly according to claim 1, characterized in that the production/injection line also comprises heat conducting means (24, 31, 44).

3.

The assembly according to claim 1 or 2, characterized in that the heating means comprise one or more heating pipes/tubes (4, 18, 26, 32) for the transport of a heating fluid.

4.

The assembly according to claim 1, characterized in that the heating means comprise one or more electrical heating cables or electrical induction cables.

5.

The assembly according to any one of the preceding claims,

PCT/NO00/00270
24 -08- 2001

characterized in that the heat conducting means (24, 31, 44) comprise a thermal conductive layer (11, 31) disposed between the heating means (4, 18, 26, 32) and the production/injection tube (1, 11, 31).

6.

The assembly according to claim 5, characterized in that recesses (19) are formed in the conductive layer (11), which recesses are adapted to the periphery of the heating means (18).

7.

The assembly according to claim 6, characterized in that the heat conducting means comprise one or more channels (26), for the transport of heating fluid, formed in the insulation layer, which channels (26) are in thermal contact with the production/injection tube (1, 11, 31).

8.

The assembly according to any of the preceding claims, characterized in that the inner channel members (5, 12, 32) have an opening into the channel of the channel member (5, 12, 32), the opening facing the production/injection tube (1, 11, 30)

9.

The assembly according to any one of the preceding claims,
characterized in that the heat conducting means comprise a heat reflective layer (24, 44) disposed outside the heating means (4, 18, 26, 32).

10.

The assembly according to any one of the preceding claims,
characterized in that the heating means comprise a thermal jacket (31) in which are formed heating fluid channels (32), which jacket (31) is in thermal contact with the production/injection tube (1, 11, 31).

11.

The assembly according to any one of the claims 5 – 10,

characterized in that the thermal conductive layer (11, 31) is made of a material that provides cathodic protection for the production/injection tube (1, 11, 31).

12.

The assembly according to any one of the preceding claims, characterized in that a continuous or intermittent temperature sensor is installed along the production/injection tube (1, 11, 31).

13.

The assembly according to any one of the preceding claims, characterized in that a continuous or intermittent pressure, tension, and/or leakage sensor is installed along the production/injection tube (1, 11, 31).

14.

The assembly according to claim 12, characterized in that the sensor is an optical sensor, preferably of the Bragg type.

15.

A method for supplying heat to a production/injection line according to any one of the preceding claims, characterized in that cooling fluid or waste fluid from a process on an installation is supplied in transport channels (4, 18, 26, 32) along a production/injection tube (1, 11, 31).

16.

The method according to claim 16, characterized in that the cooling fluid is wastewater.

17.

A method for manufacturing a production/injection line for subsea transportation of hydrocarbons, comprising a production/injection tube (1, 11, 31) which comprises a plurality of elongate members, including a core tube, which shall serve as the injection/production tube, pipes and/or cables arranged outside the core member and channel members having channels in which the pipes and/or cables are freely movable, and a protective outer casing,

characterized in that the pipeline is produced in a continuous production line where the pipes, cables, insulation means and channel members are laid around the core member, that inner channel members are first laid around the core member, that pipes and/or cables are then laid in longitudinal channels in the channel members, that outer channel members having longitudinal channels are then laid flush with the channels in the inner channel members so that the pipes and/or cables are enclosed by channel members, and that the insulation means are composed of at least a portion of the channel members.

18.

The method according to claim 17, characterized in that the insulation and heat conducting means (11, 12, 13, 24, 31, 32, 33, 44) are wound in a spiral around the core member.

19.

The method according to claims 17 and 18, characterized in that the injection- and/or production line is wound up on one or more reels of large diameter.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference P1043PC00	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/NO 00/00270	International filing date *(day/month/year)* 18 August 2000	(Earliest) Priority Date *(day/month/year)* 20 August 1999
Applicant Kvaerner Oilfield Products AS et al		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing:

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readable form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. [ ] Certain claims were found unsearchable (See Box I).

3. [ ] Unity of invention is lacking (See Box II).

4. With regard to the title,

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the abstract,

   [ ] the text is approved as submitted by the applicant.

   [X] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No. 2

   [X] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

Production/injection line, comprising a production/injection tube (1, 11, 31) and heating means (4, 18, 26, 32) for active heating of the tube (1, 11, 31). The line also comprises insulation- and heat conducting means (11, 12, 13, 24, 31, 32, 33, 44) to control the heat transfer from the heating means (4, 18, 26, 32) towards the production/injection tube (1, 11, 31).

A method is also described to supply heat to a production/injection line, in which cooling fluid or waste fluid from a process on an installation is supplied to transport channels (4, 18, 26, 32) extending along a production/injection tube (1, 11, 31).

A method is also described for manufacturing a production/injection line.

Figure 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 00/00270

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F16L 9/19, F16L 11/12
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SE 353783 B (VACUUM BARRIER CORPORATION), 12 February 1973 (12.02.73), figure 1	1,3,9
X	NO 174940 C (KVAERNER ENERGY AS), 6 August 1997 (06.08.97), figures 6-8, abstract	17-19
A		6
X	US 3548158 A (G.M. MCCASKILL), 15 December 1970 (15.12.70), figure 1, claim 1	1,2,4,5,9
X	US 4194536 A (C.R. STINE ET AL), 25 March 1980 (25.03.80), column 5, line 5 - line 8, figure 5	1-5,15,16

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 November 2000	30 -01- 2001 (20 -11- 2000)
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Axel Lindhult / MRo Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 00/00270

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4798230 A (S. HOPPERDIETZEL), 17 January 1989 (17.01.89), figure 1, claims 7,9	1,4
	--	
A	US 4288653 A (H. BLOM ET AL), 8 Sept 1981 (08.09.81), figure 3, abstract	13
	--	

SE	353783	B	12/02/73	BE	736524	A	31/12/69
				CH	530582	A	15/11/72
				DE	1936609	A,B	12/02/70
				FR	2013626	A	03/04/70
				GB	1274285	A	17/05/72
				NL	166772	C	15/09/81
				NL	6911275	A	27/01/70
				US	3565118	A	23/02/71
NO	174940	C	06/08/97	AT	165635	T	15/05/98
				AU	3649393	A	13/09/93
				BR	9305931	A	26/08/97
				DE	69318291	D,T	05/11/98
				EP	0627027	A,B	07/12/94
				NO	920689	D	00/00/00
				NO	930654	A	23/08/93
				US	5813106	A	29/09/98
				WO	9317176	A	02/09/93
US	3548158	A	15/12/70	NONE			
US	4194536	A	25/03/80	BE	861554	A	31/03/78
				CA	1080139	A	24/06/80
				JP	53077374	A	08/07/78
US	4798230	A	17/01/89	CA	1279023	A	15/01/91
				DE	8622603	U	09/10/86
				EP	0257203	A	02/03/88
				FI	873039	A	23/02/88
				NO	873465	A	23/02/88
US	4288653	A	08/09/81	BE	882378	A	16/07/80
				CA	1143670	A	29/03/83
				DE	3010346	A	15/01/81
				DE	8007385	U	03/12/81
				DK	150244	B,C	19/01/87
				DK	257780	A	19/12/80
				FI	66246	B,C	31/05/84
				FI	800789	A	19/12/80
				GB	2051294	A,B	14/01/81
				NL	180540	B,C	01/10/86
				NL	8001782	A	22/12/80
				NO	148161	B,C	09/05/83
				NO	801273	A	19/12/80
				SE	414532	B,C	04/08/80

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
8 March 2001 (08.03.2001)

PCT

(10) International Publication Number
WO 01/16515 A1

(51) International Patent Classification[7]: F16L 9/19, 11/12

(21) International Application Number: PCT/NO00/00270

(22) International Filing Date: 18 August 2000 (18.08.2000)

(25) Filing Language: Norwegian

(26) Publication Language: English

(30) Priority Data:
19994044 20 August 1999 (20.08.1999) NO

(71) Applicant *(for all designated States except US)*: KVÆRNER OILFIELD PRODUCTS AS [NO/NO]; P.O. Box 94, N-1325 Lysaker (NO).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: HEGGDAL, Ole, A. [NO/NO]; Konvallveien 55, N-1475 Finstadjordet (NO).

(74) Agent: PROTECTOR INTELLECTUAL PROPERTY CONSULTANTS AS; P.O. Box 5074 Majorstua, N-0301 Oslo (NO).

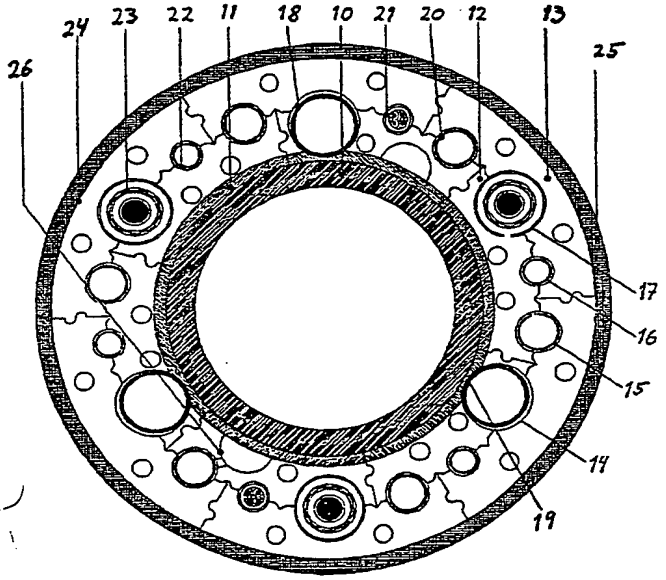
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

[Continued on next page]

(54) Title: PRODUCTION/INJECTION LINE AND METHODS RELATING TO SAME



(57) Abstract: Production/injection line, comprising a production/injection tube (1, 11, 31) and heating means (4, 18, 26, 32) for active heating of the tube (1, 11, 31). The line also comprises insulation- and heat conducting means (11, 12, 13, 24, 31, 32, 33, 44) to control the heat transfer from the heating means (4, 18, 26, 32) towards the production/injection tube (1, 11, 31). A method is also described to supply heat to a production/injection line, in which cooling fluid or waste fluid from a process on an installation is supplied to transport channels (4, 18, 26, 32) extending along a production/injection tube (1, 11, 31). A method is also described for manufacturing a production/injection line.

WO 01/16515 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Production/injection line and meth ds relating to same.

The present invention relates to a production/injection line, comprising a production/injection tube and heating means for active heating of the tube, a method for supplying heat to a production/injection line and a method for manufacturing a production/injection line, comprising a production/injection tube which comprises a plurality of elongate members, including a core tube, which shall serve as an injection/production tube, pipes and/or cables arranged outside the core member and channel members containing channels in which the pipes and/or cables are freely movable, and a protective outer casing.

Such pipelines are used for the transport of oil and/or gas between subsea installations and between subsea installations and a platform or vessel on the surface of the sea. Pipelines of this type can also be used for injection in a well.

Parallel with such production/injection lines, there are as a rule also laid one or more control cables, which are generally gathered into a control cable bundle, or a so-called "umbilical."

An umbilical of this type is known from, for example, NO 174,940 of the same applicant, where a core member, for transport of chemicals for injection in a well, is surrounded by control cables for the transfer of hydraulic fluid, electrical and optical signals, electrical power, etc.

It is known to bundle together the production line and the control cables so that these run next to each other over the whole, or parts, of the distance. By this means the risk of rupture and other damage to the cables is reduced, at the same time as it becomes easier to lay them out and, if necessary, to retrieve them again. However, the cables will have to be connected separately to the equipment on the seabed or on the surface, and it is thus necessary to have both a connector for the production line and a connector for the control cables. This connecting process takes considerable time and involves significant costs, in addition to occupying a relatively large area.

From GB 1,210,206 it is known to integrate the control cables with the production line by having the control cables wound around the production line. This ensures that the production line and the control cables will always stay together.

Also, it is desirable to hold the temperature of the production fluid (oil and/or gas) in the production line as high as is practically possible, which is to say a temperature of 50-100°C. This is because a lower temperature could cause the production fluid to have a higher viscosity and, as a result, to have a reduced flow rate. In addition, it is possible for wax to form, which accumulates on the tube wall and narrows the cross section of the tube.

There have been attempts to avoid this problem by means of the pipeline according to EP 521,582, where electrical heating cables are arranged next to the pipeline. There is also arranged an insulation layer around the pipeline. In NO 170,695 the heat loss from electrical transmission elements is used to heat up the pipeline.

The disadvantage with this known art is primarily that the electrical cables require special equipment for the generation of electrical current. The heating cables require considerable energy and can also represent an explosion risk.

The present invention is characterized in that it comprises insulation means to control the heat transfer from the heating means in toward the production/injection tube.

The method for supplying heat to the production/injection line is characterized in that cooling fluid or waste fluid from a process on an installation is supplied in transport channels extending along a production/injection tube.

The heating means in one variant of the invention consists of a pipe or tube for the transport of heating fluid. The pipe or tube may be wound around the pipeline and may optionally lie in the same insulation layer as the control cables.
The heating fluid may be, for example, cooling fluid or wastewater that is used to cool down motors and other equipment on board a platform or a vessel. This water may be supplied through the heating pipe or tube and can contribute towards maintaining the

temperature level of the oil or the gas. Even if the cooling fluid were not to sustain a temperature of 50-100°C, it would still be useful for the heating of the production/injection line and could ensure that the insulation layer is not cooled down by the cold surrounding sea water.

In another variant of the present invention the means consists of an electrical heating cable or an electrical induction cable.

In a preferred embodiment form of the present invention, the insulation layer comprises inner and/or outer channel members arranged around the production/injection line, with the cables that are wound around the production/injection line being located within the channels inside these channel members. The channel members may also be wound continuously around the production/injection line in the same manner as the cables.

The winding of the cables and/or the channel members can be done either in helical form or as a so-called Z-winding. However, it is also entirely possible, in certain embodiments, to align the channel members parallel with the tube without winding.

In a further variant of the present invention, transport channels for heating fluid are formed directly in the channel members.

For protection of the production/injection tube and optionally other exterior pipes, these may be coated on the outside with a corrosion-preventive coating or may have an increased wall thickness in the form of a corrosion adjunct.

The method for manufacturing the production/injection line is characterized in that the pipeline is produced in a continuous production line where the pipes, cables, insulation means and channel members are laid around the core member, that inner channel members are first laid around the core member, that pipes and/or cables are then laid in longitudinal channels in the channel members, that outer channel members having longitudinal channels are then laid flush with the channels of the inner channel members so that the pipes and/or cables are enclosed by channel members, and that the insulation

means are laid either as separate members or are composed of at least a portion of the channel members.

The invention shall now be described in more detail in the following, with the aid of embodiment examples and with reference to the accompanying figures, where:

Figure 1 shows a cross section through a production line according to the invention in a first embodiment form,

Figure 2 shows a cross section through a production line according to the invention in a second embodiment form,

Figure 3 shows a cross section through a production line according to the invention in another embodiment form,

Figure 4 shows a block diagram illustrating a method for manufacturing a production/injection line and

Figure 5 shows a manufacturing plant for the production of a pipeline.

In a first embodiment form shown in Figure 1, the production line comprises a production tube 1 having a central bore 2 therethrough for the transport of a production fluid. On the exterior of production tube 1 are wound control cables 3 and heating pipes 4. In the figure there are shown five electrical control cables, five control cables for control fluid (for example hydraulic oil) and five heating pipes, but the number of these elements and the relationship between them may, of course, be varied according to need.

A plurality of inner channel members 5 are arranged around production tube 1. In the inner channel members 5 are formed channels 6, in which the control cables and the heating pipes can be located. The outer channel member 7 is disposed exterior to inner channel members 5. Outer channel members 7 are also provided with channels 8, which respectively, together with a channel 6, form a closed cross section, in which a

control cable 3 or a heating pipe 4 is located. Exterior to outer channel members 7 is provided an outer casing 9, which serves to hold channel members 5 and 7 in place, as well as to provide protection against the seawater.

The channel members 5 and 7 preferably are made of plastic, for example PVC foam, which has good thermal insulation properties. At the same time, channel members 5, 7 have a certain impact strength and can therefore serve to protect the control cables and production tube against stresses. The control cables and the heating pipes lie situated with a certain degree of play within channel members 5 and 7 and are thus able to move slightly with respect to each other and in relation to production tube 1. Channel members 5, 7 may be designed so as to have a lower heat transition coefficient on the side facing production tube 1, for example, by virtue of the fact that inner channel members 5 are thinner or consist of a material having better heat conduction properties.

The heating pipes/tubes may be designed as pipes for the transport of a heating fluid, for example water, oil or gas. Preferably there is used cooling fluid from processes on board a platform or a production vessel for heating the production line.

Another embodiment form in accordance with the invention is shown in Figure 2. Here there is also provided a central production tube 10. Around production tube 10 is arranged a layer 11 of a material having good thermal conductivity. Outside conductive layer 11 are arranged inner profile members or channel members 12. These members 12 are made of a material having high thermal insulating power, for example PVC foam or solid PVC. Together with outer profile members or channel members 13, which are also produced from a material with good thermal insulation properties, they define the channels 14, 15, 16 and 17 in the inner channel member 12. In channels 14 are provided heating pipes 18, which are in good thermal contact with conductive layer 11. Preferably there are formed recesses 19 in conductive layer 11 that are adapted to the periphery of heating pipes 18.

In channels 15 are arranged fluid pipes 20 for the transfer of, for example, hydraulic oil. In channels 16 are arranged electrical signal cables 21 or fluid pipes 22. In channels 17 are arranged electrical power cables 23, preferably for the transmission of high voltage.

Outside channel members 13 is provided a reflective layer 24, which is adapted to reflect heat radiation in towards production tube 10. On the outermost surface is provided an outer casing 25, intended to hold the interior components in place and to protect them from exterior stresses, such as seawater and shocks/blows.

As an alternative or an addition to heating pipes 18, there may be formed heating channels 26 in the inner channel members 12. These heating channels may well have a semicircular cross section, enabling them to present a large surface toward conductive layer 11. Channels 26 are adapted to conduct a heat transport fluid, for example wastewater, from a process on an installation. They may well be completely sealed against leakage, but a moderate leakage can readily be tolerated.

The conductive layer may also be made of a material that provides cathodic protection for the production tube. The layer need not completely enclose the production tube, but may consist of a plurality of segments.

In a third embodiment form, shown in Figure 3, the production/injection line comprises a production tube 30. Exterior to this is provided a thermal jacket 31, in which are formed a plurality of heating channels 32. The thermal jacket is made of a material having good thermal conductivity. Outside thermal jacket 31 are arranged inner profile members or channel members 32. These members 32 are made of a material with high thermal insulating power, for example PVC foam or solid PVC. Together with outer profile members or channel members 33, which are also made of material having good thermal insulation properties, they define channels 34, 35, 36 and 37 of inner channel members 32. In channels 34 may be provided heating pipes 38, which function as a supplement to thermal jacket 31. Alternatively the thermal jacket may function alone as a heating device.

In channels 35 are provided fluid pipes 40 for the transmission of, for example, hydraulic oil. In channels 36 are provided electrical signal cables 41 or fluid pipes 42. In channels 37 are provided electrical power cables 43, preferably for the transmission of high voltage.

Outside channel members 33 is provided a reflective layer 44, which is adapted to reflect heat radiation in towards production tube 30. On the outermost surface is provided an outer casing 45, intended to hold the interior components in place and to protect them against exterior stresses, such as seawater and shocks/blows.

The thermal jacket may be made of a material that provides cathodic protection for the production tube. The layer need not completely enclose the production tube, but may consist of a plurality of segments.

Instead of heating pipes that transport heating fluid, there may also be used electrical heating cables or electrical conductors that transmit heat with the aid of induction. In the latter case, conductive layer 11 or thermal jacket 31 may be constructed of a material that is readily heated by induction from externally situated electrical conductors. Optionally the energy loss from electrical high voltage conductors 23, 43 can be used for induction of heat in the conductive layer 11 or thermal jacket 31.

Temperature sensors may be mounted continuously along the production/injection line or at predetermined locations in order to monitor the temperature of the heating fluid and/or tubing stream. The monitoring may be either continuous or intermittent. The temperature sensors are able to transmit signals to an installation either via their own wires or via one of the other electrical cables.

The temperature sensors are preferably of fiber optic type. As examples of such optical temperature sensors are those that have been developed by I.D. FOS Research. They are fiber optic sensors based on so-called Bragg grids. These are grids that comprise a filter that allows penetration by specific wavelengths and a mirror that reflects light of particular wavelengths. The output distance between the filter and the mirror is known. A change in temperature will bring about a change in the distance between the filter and the mirror; this change in distance will, in turn, result in an alteration of the wavelength, which is possible to detect. By positioning the grids that will let through and reflect light of varying wavelengths at different locations in the optical fiber, the temperature

can be measured at these locations. With current technology it is possible to have 30 test points incorporated in one and the same fiber, distributed over a distance of 2 km.

By mounting the sensor in different types of fixtures and connecting it to various additional components, it is possible to use the same type of technology also to measure tension, pressure and other parameters that may be important for the production/injection line, for example in order to monitor against leakage or damages.

Since the optical fibers are quite thin, and the sensors have a diameter that is not substantially greater than that of the actual fiber, it is quite easy to incorporate these into the production/ injection line, and the sensors can therefore be placed at or very close to the location where it is most desirable to carry out the measurement.

Fiber optic sensors are unaffected by, for example, nearby electrical conductors and will therefore yield reliable measurements under extreme conditions.

Channel members 12, 13, 22, 23 and the pipes/cables are expediently coiled around the production tube in a winding process similar to the one described in Norwegian patent 174,940 by the same applicant.

A method for manufacturing the production/injection line shall now be described with reference to Figures 4 and 5.

In Figure 4 is shown a block diagram illustrating the stages of the method. At 50 there is provided a prefabricated insulation material, which may be housed, for example, in long lengths on a roll. At 51 there are provided prefabricated tubes/pipes, which may also be supplied in long lengths on a roll, where one roll is provided for each tube to be installed in the pipeline. At 52 there are provided the various cables and other conductors, which are also supplied in long lengths on a roll, with one roll for each cable, etc.

At 53 the insulation material, pipes, cables, etc., are wrapped around the central tube in a continuous process, which shall be explained in more detail with reference to Figure 5.

At 54 the outer protective casing is applied, at 55 the pipeline is coiled up for storage in long lengths, and at 56 the pipeline is transported to a transport vessel for installation.

Figure 5 shows a manufacturing plant for the continuous production of a pipeline in stage 53 according to Figure 4. The plant comprises a plurality of stations, shown as stations I –VII, with the number of stations being dependent on the number of layers or members of which the pipeline to be manufactured will consist.

A core member 105, which can be injection/production tube 10, 30, optionally provided with a conductive layer 11 or a thermal jacket 31, is drawn in a straight line into the plant with the aid of a pulling means 115 in station I.

In station II is shown a rotating disc 121, which is rotatable about an axis 122 coincidental with the center axis of core member 115. On disc 121 is mounted a plurality of reels 103, which are rotatable about their longitudinal axes 114. Each reel 103 can be provided with a brake, if there is a need for this. Reels 103 contain coiled inner channel members 5, 32. Channel members 5, 32 are laid next to each other on the core member in a spiral configuration. A funnel means 130 ensures the proper laying of the channel members.

In station III is provided a rotating disc 122, which is similar to disc 121, but where reels 104 contain pipes, cables, etc., which are to be arranged around the core member.

Each of reels 104 is rotatably mounted on the rotating disc, such that the rotational axes of reels 104 are constantly maintained in the same direction, to prevent the pipes and cables from becoming twisted about their own axes.

Station IV is essentially the same as station III, but contains additional pipes and cables received on reels 104 on a rotating disc 122. It is of no significance per se whether

pipes or cables are wound on reels 103 in station II in addition to the channel members, or which pipes or cables are received on reels 104 in station III or IV. The number of stations that will be required depends on how many pipes or cables are to be laid in the pipeline.

In station V is provided a linear pulling means 116, for example, a linear winch, which pulls in the pipes, cables and inner channel members in such a manner that these are drawn in by their respective reels. A funnel means 125 provided after each of stations III and IV ensures that the pipes and cables are laid property in channels 6, 34, 35, 36, 37 of the inner channel members 5, 32.

In station VI is provided a rotating disc 110 having reels 113 for outer channel members 7, 33. These channel members are laid on the outside of the pipes and cables in such a manner that the outer channel members remain lying on the opposite side of the pipes and cables with respect to the inner channel members. A funnel means 131 ensures that the outer channel members are laid on properly. In other respects station VI functions in the same manner as station II.

In station VII a band and/or an outer casing is wound around the pipeline.

With the aforementioned method there can be manufactured complete injection- and/or production lines in a continuous length that far exceeds what has hitherto been accomplished. Until now it has not been possible to produce tubing lengths of a diameter greater than about 3" in continuous lengths. With the method described above, it is possible to manufacture pipelines having a central tube with a diameter of up to 15".

The central tube should be made of a material that permits a cold deformation of a minimum of 5-15%, so that the pipeline may be coiled one or more times on large reels.

Patent Claims

1.
A production/injection line assembly, comprising a production/injection tube (1, 11, 31) and heating means (4, 18, 26, 32) for active heating of the tube (1, 11, 31), characterized in that it also comprises along the production/injection line, over at least 100 m, continuous insulation means (11, 12, 13, 32, 33) to control the heat transfer from the heating means (4, 18, 26, 32) in towards the production/injection tube (1, 11, 31).

2.
The assembly according to claim 1, characterized in that the production/injection line also comprises heat conducting means (24, 31, 44).

3.
The assembly according to claim 1 or 2, characterized in that the heating means comprise one or more heating pipes/tubes (4, 18, 26, 32) for the transport of a heating fluid.

4.
The assembly according to claim 1, characterized in that the heating means comprise one or more electrical heating cables or electrical induction cables.

5.
The assembly according to any one of the preceding claims, characterized in that the heat conducting means (24, 31, 44) comprise a thermal conductive layer (11, 31) disposed between the heating means (4, 18, 26, 32) and the production/injection tube (1, 11, 31).

6.
The assembly according to claim 5, characterized in that recesses (19) are formed in the conductive layer (11), which recesses are adapted to the periphery of the heating means (18).

7.

The assembly according to any one of the preceding claims, characterized in that the insulation means comprise a thermal insulating layer, preferably comprising channel members (5, 7, 12, 13, 31, 32), disposed substantially outside the heating means (4, 18, 26, 32).

8.

The assembly according to claim 6, characterized in that the heat conducting means comprise one or more channels (26), for the transport of heating fluid, formed in the insulation layer, which channels (26) are in thermal contact with the production/injection tube (1, 11, 31).

9.

The assembly according to any one of the preceding claims, characterized in that the heat conducting means comprise a heat reflective layer (24, 44) disposed outside the heating means (4, 18, 26, 32).

10.

The assembly according to any one of the preceding claims, characterized in that the heating means comprise a thermal jacket (31) in which are formed heating fluid channels (32), which jacket (31) is in thermal contact with the production/injection tube (1, 11, 31).

11.

The assembly according to any one of the claims 5 – 10, characterized in that the thermal conductive layer (11, 31) is made of a material that provides cathodic protection for the production/injection tube (1, 11, 31).

12.

The assembly according to any one of the preceding claims, characterized in that a continuous or intermittent temperature sensor is installed along the production/injection tube (1, 11, 31).

13.

The assembly according to any one of the preceding claims, characterized in that a continuous or intermittent pressure, tension, and/or leakage sensor is installed along the production/injection tube (1, 11, 31).

14.

The assembly according to claim 12, characterized in that the sensor is an optical sensor, preferably of the Bragg type.

15.

A method for supplying heat to a production/injection line, characterized in that cooling fluid or waste fluid from a process on an installation is supplied in transport channels (4, 18, 26, 32) along a production/injection tube (1, 11, 31).

16.

The method according to claim 15, characterized in that the cooling fluid is wastewater.

17.

A method for manufacturing a production/injection line, comprising a production/injection tube (1, 11, 31) which comprises a plurality of elongate members, including a core tube, which shall serve as the injection/production tube, pipes and/or cables arranged outside the core member and channel members having channels in which the pipes and/or cables are freely movable, and a protective outer casing, characterized in that the pipeline is produced in a continuous production line where the pipes, cables, insulation means and channel members are laid around the core member, that inner channel members are first laid around the core member, that pipes and/or cables are then laid in longitudinal channels in the channel members, that outer channel members having longitudinal channels are then laid flush with the channels in the inner channel members so that the pipes and/or cables are enclosed by channel members, and that the insulation means are laid either as separate members or are composed of at least a portion of the channel members.

18.

The method according to claim 17, c h a r a c t e r i z e d i n that the insulation and heat conducting means (11, 12, 13, 24, 31, 32, 33, 44) are wound in a spiral around the core member.

19.

The method according to claims 17 and 18, c h a r a c t e r i z e d i n that the injection- and/or production line is wound up on one or more reels of large diameter.

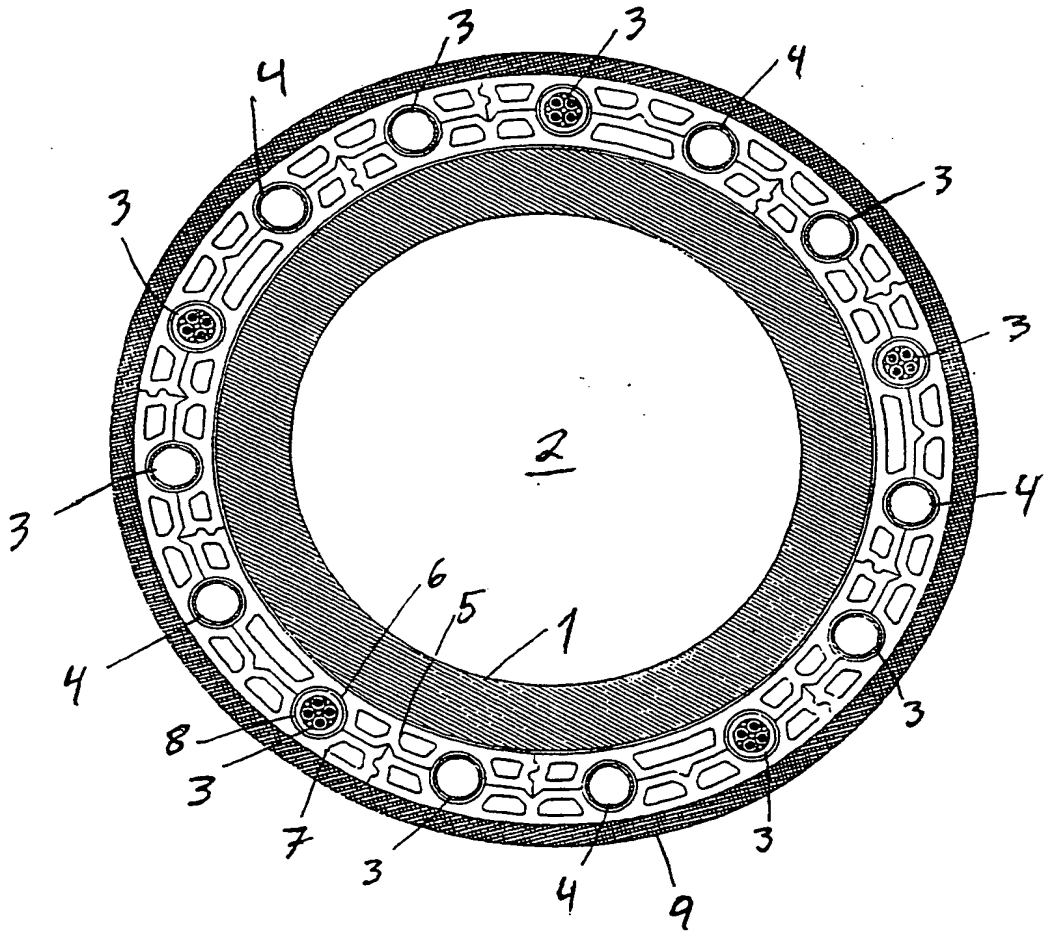


Fig.1

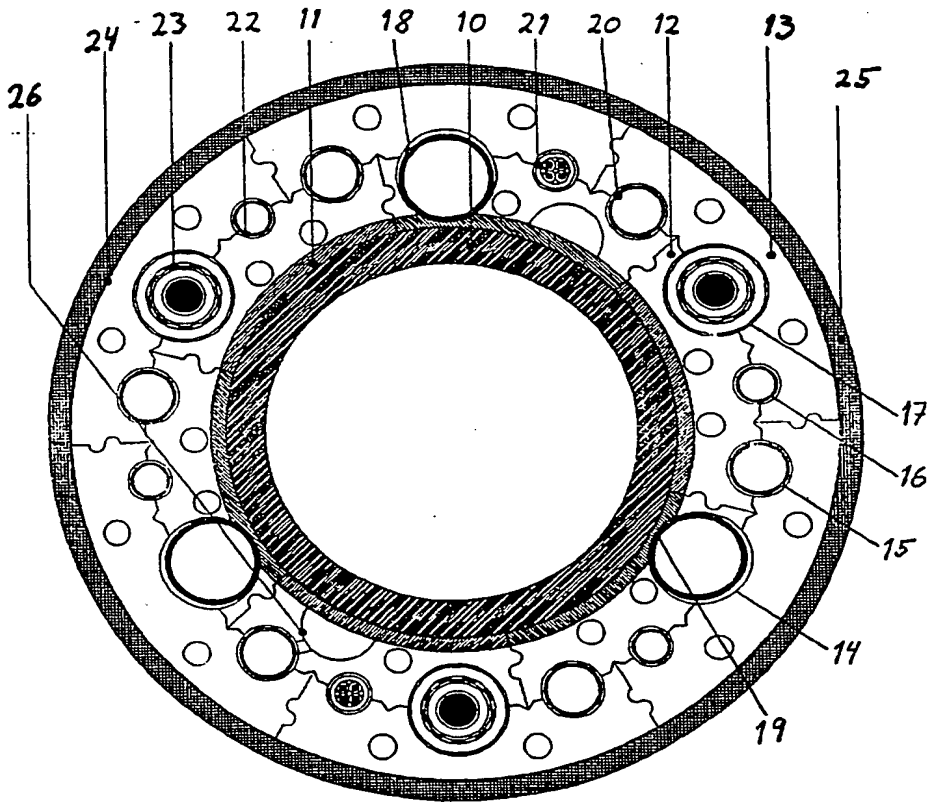


Fig. 2

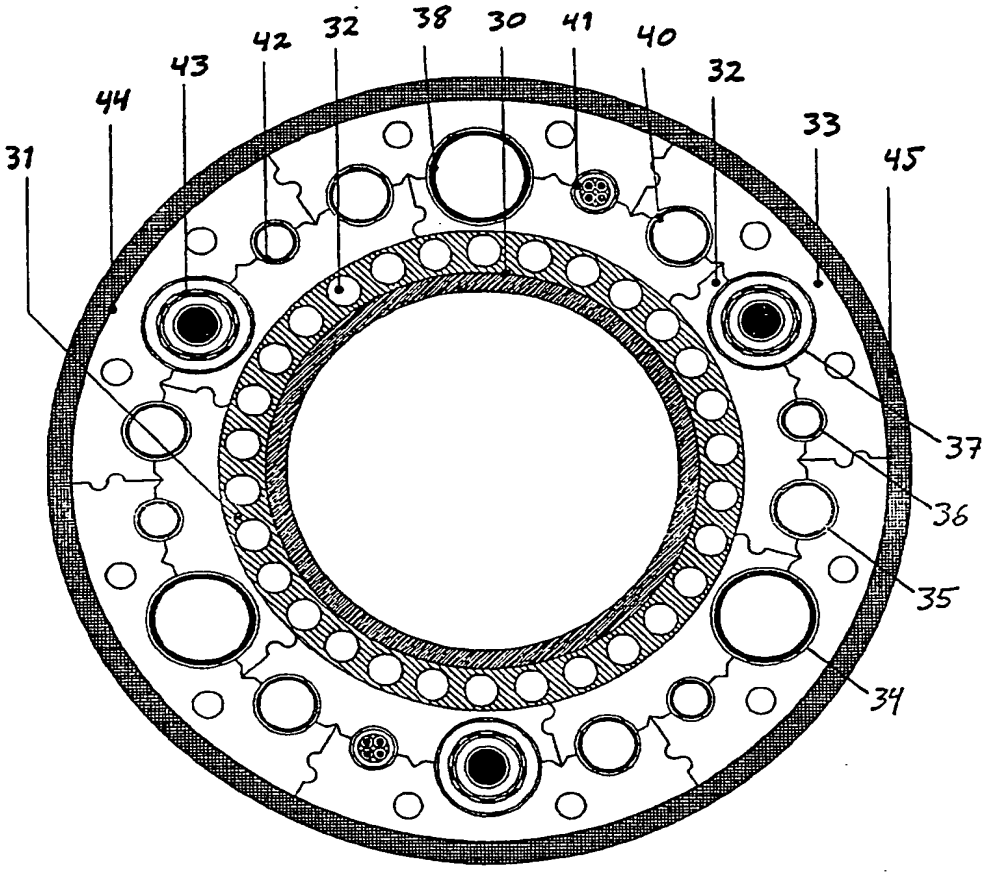


Fig. 3

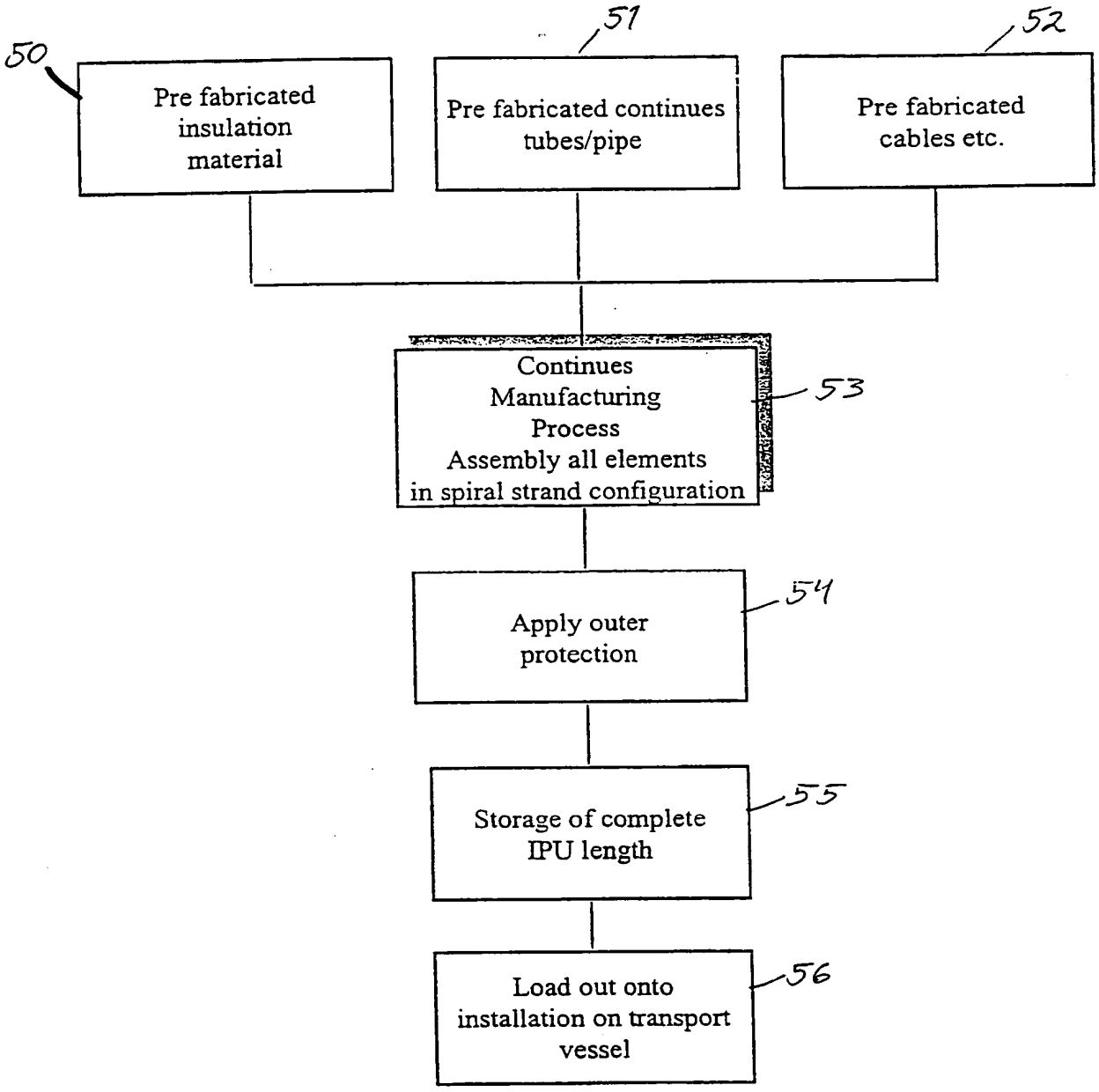

50
Pre fabricated insulation material
51
Pre fabricated continues tubes/pipe
52
Pre fabricated cables etc.
Continues Manufacturing Process Assembly all elements in spiral strand configuration
53
Apply outer protection
54
Storage of complete IPU length
55
Load out onto installation on transport vessel
56

Fig. 4

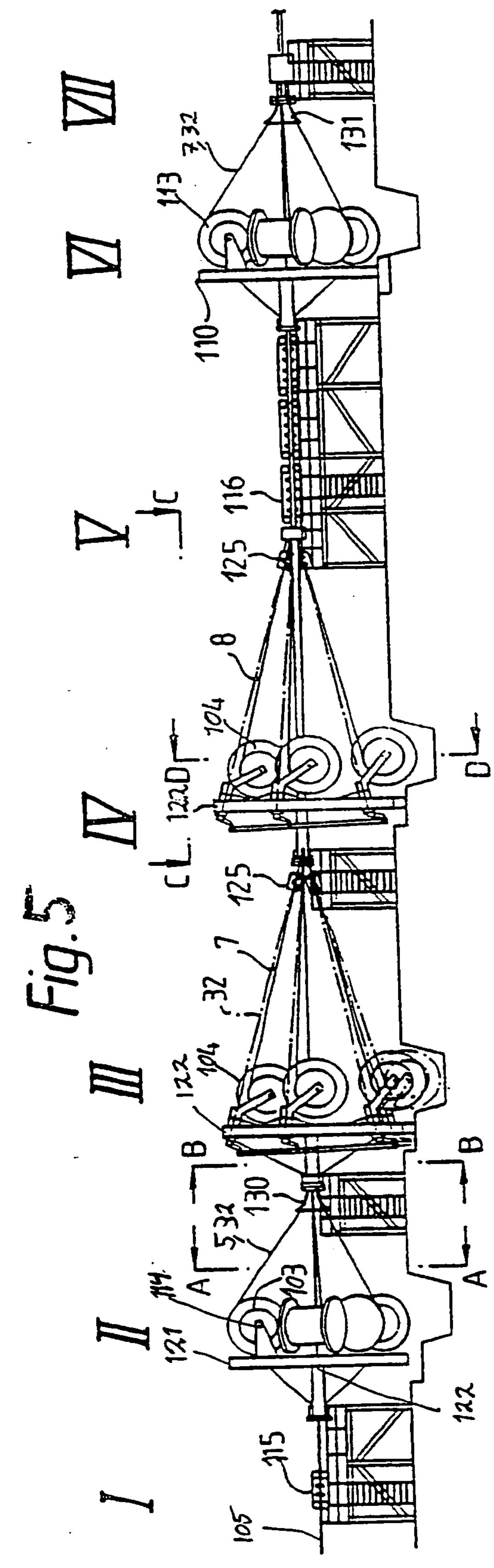

I
II
III
IV
V
VI
VII
105
115
121
122
114
103
5,32
130
A
B
104
32
7
125
C
122D
D
8
116
110
113
7,32
131

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 00/00270

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F16L 9/19, F16L 11/12
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SE 353783 B (VACUUM BARRIER CORPORATION), 12 February 1973 (12.02.73), figure 1	1,3,9
X	NO 174940 C (KVAERNER ENERGY AS), 6 August 1997 (06.08.97), figures 6-8, abstract	17-19
A		6
X	US 3548158 A (G.M. MCCASKILL), 15 December 1970 (15.12.70), figure 1, claim 1	1,2,4,5,9
X	US 4194536 A (C.R. STINE ET AL), 25 March 1980 (25.03.80), column 5, line 5 - line 8, figure 5	1-5,15,16

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 November 2000	30 -01- 2001
Name and mailing address of the ISA: Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Axel Lindhult / MRo Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 00/00270

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4798230 A (S. HOPPERDIETZEL), 17 January 1989 (17.01.89), figure 1, claims 7,9	1,4
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A	US 4288653 A (H. BLOM ET AL), 8 Sept 1981 (08.09.81), figure 3, abstract	13
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				DE	1936609	A,B	12/02/70
				FR	2013626	A	03/04/70
				GB	1274285	A	17/05/72
				NL	166772	C	15/09/81
				NL	6911275	A	27/01/70
				US	3565118	A	23/02/71
NO	174940	C	06/08/97	AT	165635	T	15/05/98
				AU	3649393	A	13/09/93
				BR	9305931	A	26/08/97
				DE	69318291	D,T	05/11/98
				EP	0627027	A,B	07/12/94
				NO	920689	D	00/00/00
				NO	930654	A	23/08/93
				US	5813106	A	29/09/98
				WO	9317176	A	02/09/93
US	3548158	A	15/12/70	NONE			
US	4194536	A	25/03/80	BE	861554	A	31/03/78
				CA	1080139	A	24/06/80
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				DE	8622603	U	09/10/86
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				FI	873039	A	23/02/88
				NO	873465	A	23/02/88
US	4288653	A	08/09/81	BE	882378	A	16/07/80
				CA	1143670	A	29/03/83
				DE	3010346	A	15/01/81
				DE	8007385	U	03/12/81
				DK	150244	B,C	19/01/87
				DK	257780	A	19/12/80
				FI	66246	B,C	31/05/84
				FI	800789	A	19/12/80
				GB	2051294	A,B	14/01/81
				NL	180540	B,C	01/10/86
				NL	8001782	A	22/12/80
				NO	148161	B,C	09/05/83
				NO	801273	A	19/12/80
				SE	414532	B,C	04/08/80

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2000 -08- 18

PCT REQUEST

P1043PC00

Original (for **SUBMISSION**) - printed on 18.08.2000 08:40:55 AM

0 0-1	**For receiving Office use only** International Application No.	PCT/NO 0 0 0 0 2 7 0
0-2	International Filing Date	18 AUG. 2000 (18.08.00)
0-3	Name of receiving Office and "PCT International Application"	PATENTSTYRET Styret for det industrielle rettsvern PCT International application
0-4 0-4-1	**Form - PCT/RO/101 PCT Request** Prepared using	PCT-EASY Version 2.91 (updated 01.07.2000)
0-5	**Petition** The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	**Receiving Office (specified by the applicant)**	Norwegian Patent Office (RO/NO)
0-7	**Applicant's or agent's file reference**	P1043PC00
I	**Title of invention**	PRODUCTION/INJECTION LINE AND METHODS RELATING TO SAME
II II-1 II-2 II-4 II-5 II-6 II-7 II-8 II-9	**Applicant** This person is: Applicant for Name Address: State of nationality State of residence Telephone No. Facsimile No.	 applicant only all designated States except US KVÆRNER OILFIELD PRODUCTS AS P.O.Box 94 N-1325 Lysaker Norway NO NO +47-6782.6000 +47-6782.6400
III-1 III-1-1 III-1-2 III-1-4 III-1-5 III-1-6 III-1-7	**Applicant and/or inventor** This person is: Applicant for Name (LAST, First) Address: State of nationality State of residence	 applicant and inventor US only HEGGDAL, Ole, A. Konvallveien 55 N-1475 Finstadjordet Norway NO NO

PCT REQUEST

P1043PC00

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IV-1	**Agent or comm n representative; or address for correspondence** The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name	PROTECTOR INTELLECTUAL PROPERTY CONSULTANTS AS
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IV-1-5	e-mail	mail@protectpat.no
V	**Designation of States**	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AP: GH GM KE LS MW MZ SD SL SZ TZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH&LI CN CR CU CZ DE DK DM DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW
V-5	**Precautionary Designation Statement** In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.	
V-6	**Exclusion(s) from precautionary designations**	NONE

PCT REQUEST

P1043PC00

Original (for **SUBMISSION**) - printed on 18.08.2000 08:40:55 AM

VI-1	**Priority claim f earlier nati nal applicati n**		
VI-1-1	Filing date	20 August 1999 (20.08.1999)	
VI-1-2	Number	1999 4044	
VI-1-3	Country	NO	
VI-2	**Priority document request** The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):	VI-1	
VII-1	**International Searching Authority Chosen**	Swedish Patent Office (ISA/SE)	
VIII	**Check list**	number of sheets	electronic file(s) attached
VIII-1	Request	3	-
VIII-2	Description	9	-
VIII-3	Claims	4	-
VIII-4	Abstract	1	p1043pc00-abstract.txt
VIII-5	Drawings	5	-
VIII-7	TOTAL	22	
	Accompanying items	paper document(s) attached	electronic file(s) attached
VIII-8	Fee calculation sheet	✓	-
VIII-16	PCT-EASY diskette	-	diskette
VIII-18	**Figure of the drawings which should accompany the abstract**	2	
VIII-19	**Language of filing of the international application**	Norwegian	
IX-1	**Signature of applicant or agent**		
IX-1-1	Name	PROTECTOR INTELLECTUAL PROPERTY CONSULTANTS AS	
IX-1-2	Name of signatory	Arild Tofting	
IX-1-3	Capacity	Patent Attorney	

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10-1	**Date of actual receipt of the purported international application**	18 AUG. 2000 (18.08.00)
10-2	**Drawings:**	
10-2-1	Received	Received
10-2-2	Not received	
10-3	**Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application**	
10-4	**Date of timely receipt of the required corrections under PCT Article 11(2)**	
10-5	**International Searching Authority**	ISA/SE
10-6	**Transmittal of search copy delayed until search fee is paid**	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	**Date of receipt of the record copy by the International Bureau**	19 SEPTEMBER 2000 (19.09.00)

Abstract

Production/injection line, comprising a production/injection tube (1, 11, 31) and heating means (4, 18, 26, 32) for active heating of the tube (1, 11, 31). The line also comprises insulation- and heat conducting means (11, 12, 13, 24, 31, 32, 33, 44) to control the heat transfer from the heating means (4, 18, 26, 32) towards the production/injection tube (1, 11, 31).

A method is also described to supply heat to a production/injection line, in which cooling fluid or waste fluid from a process on an installation is supplied to transport channels (4, 18, 26, 32) extending along a production/injection tube (1, 11, 31).

A method is also described for manufacturing a production/injection line.

Figure 2

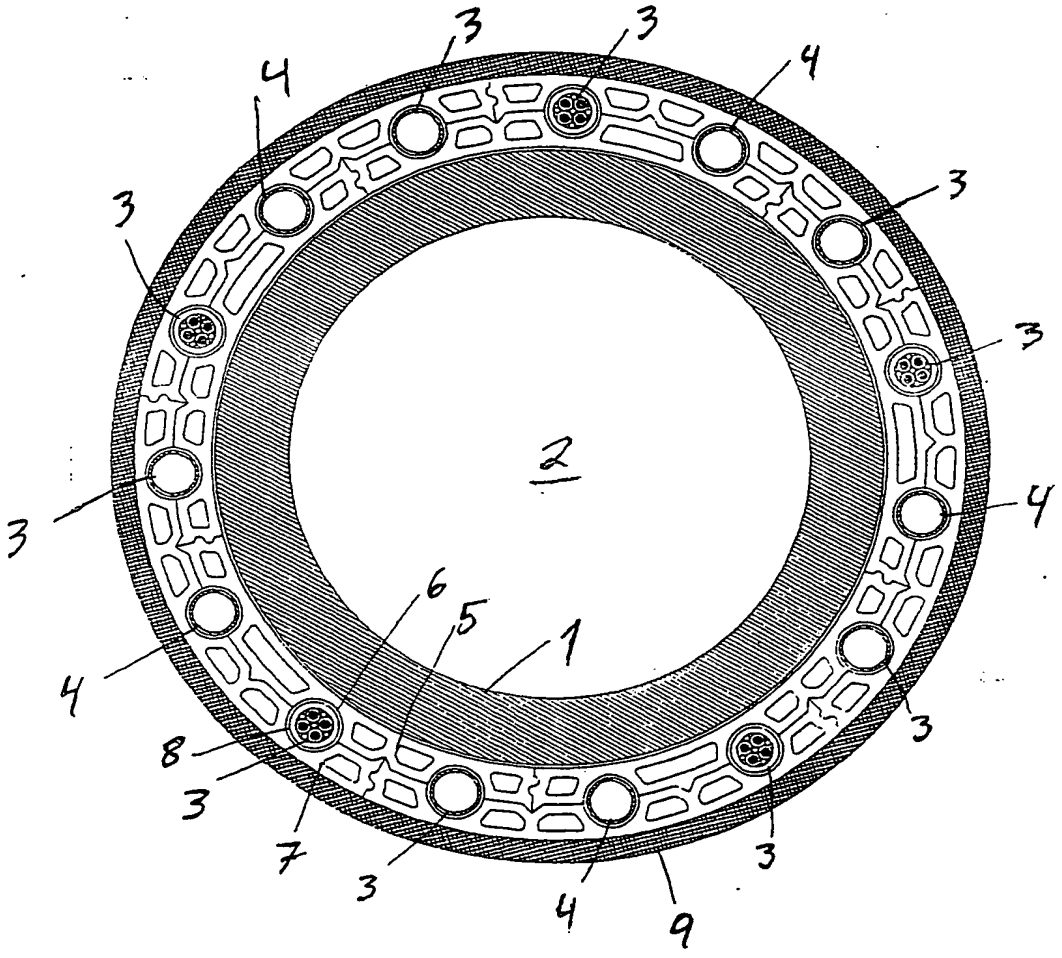

Fig. 1

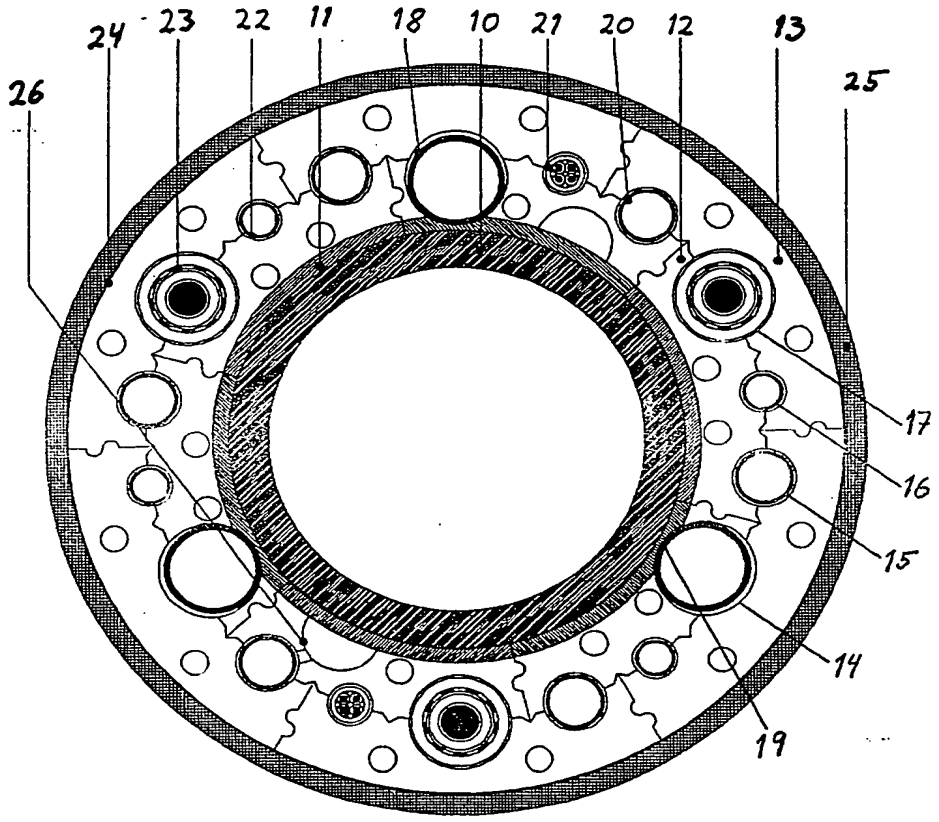

Fig. 2

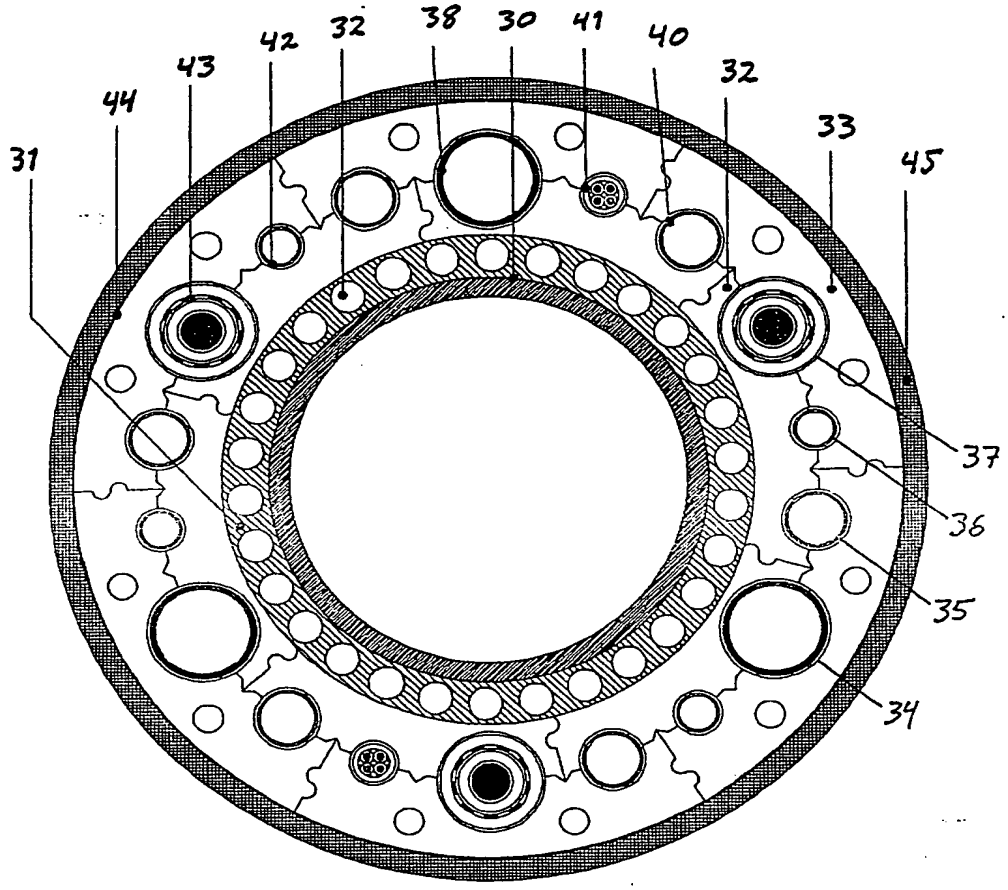

Fig. 3

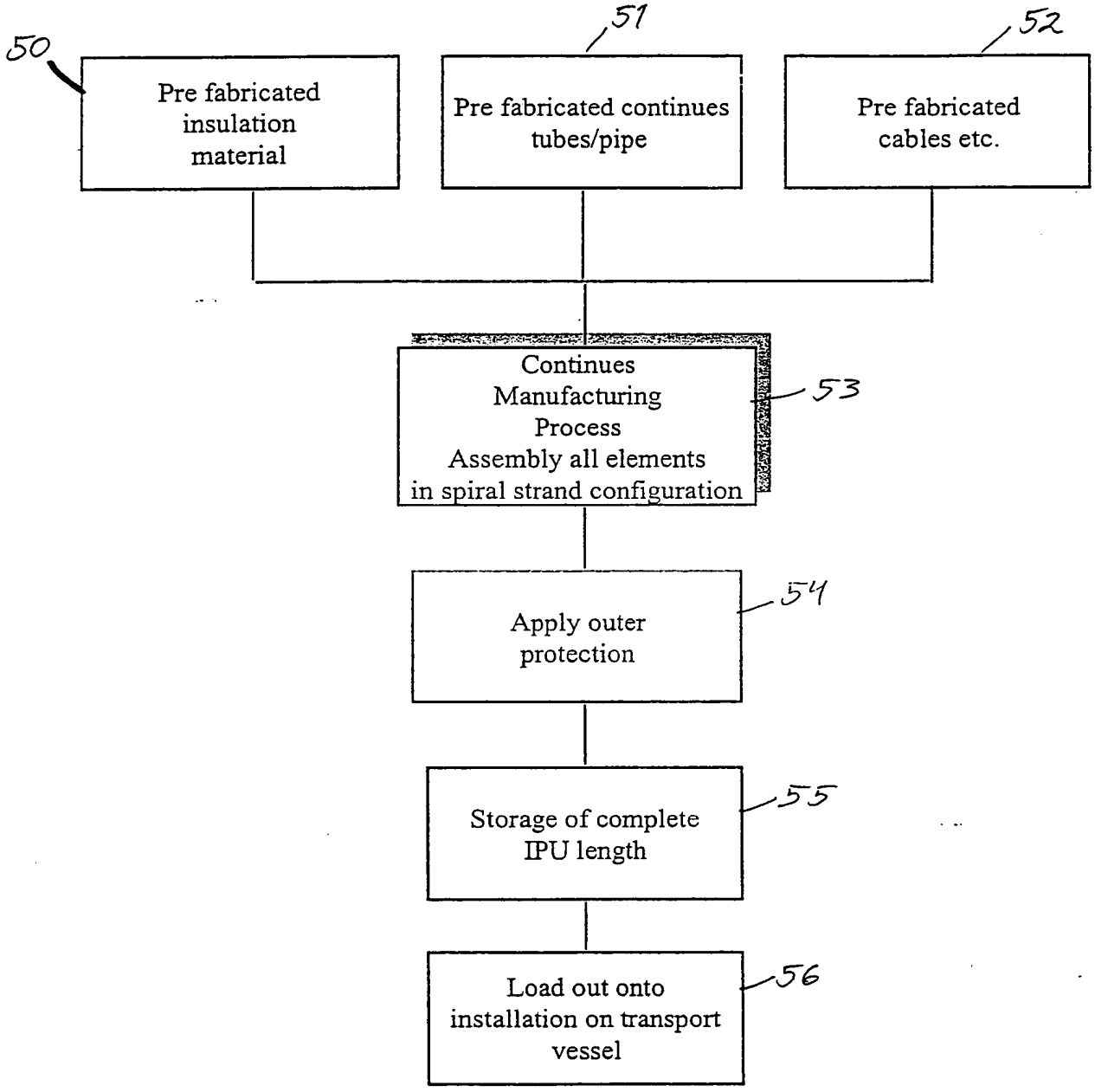
50
Pre fabricated insulation material
51
Pre fabricated continues tubes/pipe
52
Pre fabricated cables etc.
Continues Manufacturing Process Assembly all elements in spiral strand configuration
53
Apply outer protection
54
Storage of complete IPU length
55
Load out onto installation on transport vessel
56

Fig. 4

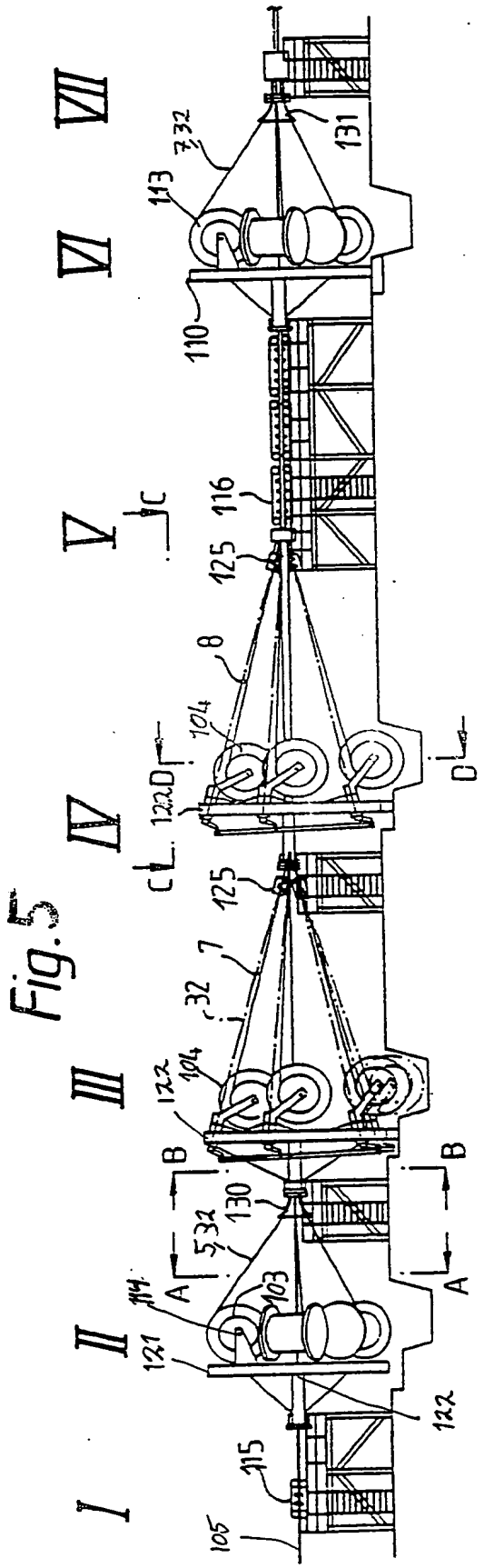
I
II
III
IV
V
VI
VII
105
115
121
114
A
103
532
130
B
122
104
32
7
125
C
122D
D
8
116
110
113
131

Fig. 5

Anordning og fremgangsmåter ved produksjons-/injeksjosrørledning

Den foreliggende oppfinnelse vedrører en anordning ved produksjons-/injeksjonsrørledning, omfattende et produksjonsrør/injeksjonsrør og oppvarmingsmidler for aktiv oppvarming av røret, en fremgangsmåte for å tilføre varme til en produksjons-/injeksjonsrørledning og en fremgangsmåte for å fremstille produksjons-/injeksjonsrørledning, omfattende et produksjonsrør/injeksjonsrør omfattende flere langstrakte elementer, innbefattende et kjernerør, som skal tjene som injeksjon-/produksjonsrør, rør og/eller kabler anordnet utenfor kjerneelementet og kanalelementer med kanaler i hvilke rørene og/eller kablene er fritt bevegelige, samt en beskyttende ytre omhylning.

Slike rørledninger anvendes for transport av olje og/eller gass mellom undersjøiske installasjoner og mellom undersjøiske installasjoner og en plattform eller skip på havoverflaten. Rørledninger av denne typen kan også anvendes for injeksjon i en brønn.

Parallelt med slike produksjons-/injeksjonsrørledninger legges det som regel også en eller flere kontrollkabler, som som regel er sammenfattet til en kontrollkabelbunt eller en såkalt "umbilical".

En slik umbilical er kjent fra for eksempel NO 174.940 av samme søker, der et kjerneelement , for transport av kjemikalier for injeksjon i en brønn, er omgitt av kontrollkabler for overføring av hydraulisk fluid, elektriske og optiske signaler, elektrisk kraft m.m.

Det er kjent å bunte sammen produksjonsrørledningen og kontrollkablene slik at disse løper inntil hverandre over hele eller deler av strekningen. På denne måten reduseres risikoen for brudd og annen skade på kablene samtidig som det blir lettere å legge disse ut og eventuelt ta de opp igjen. Imidlertid vil kablene måtte tilkobles utstyret på havbunnen eller ved overflaten separat, og det er derfor behov både for en konnektor for produksjonsrørledningen og en konnektor for kontrollkablene. Denne oppkoblingen tar betydelig tid og involverer betydelige kostnader, foruten at den tar forholdsvis stor plass.

Det er fra GB 1.210.206 kjent å integrere kontrollkablene med produksjonsrørledningen ved at kontrollkablene vikles rundt produksjonsrørledningen. På denne måten sikres det at produksjonsrørledningen og kontrollkablene alltid følger hverandre.

Videre er det ønskelig å holde temperaturen på produksjonsfluidet (olje og/eller gass) i produksjonsrørledningen så høy som praktisk mulig, hvilket vil si ved en temperatur på 50 - 100°C. Dette fordi lavere temperatur vil kunne medføre at produksjonsfluidet får høyere viskositet og derved får redusert stømningshastighet. Dessuten kan det dannes voks, som legger seg på rørveggen og innsnevrer rørtverrsnittet.

Dette problemet er søkt unngått ved rørledningen ifølge EP 521.582, der det er anordnet elektriske varmekabler inntil rørledningen. Det er også anordnet et isolasjonssjikt rundt rørledningen. I NO 170.695 benyttes tapsvarme fra elektriske transmisjonselementer til å varme opp rørledningen.

Ulempen med den kjente teknikken er primært at de elektriske kablene krever spesialutstyr for generering av elektrisk strøm. Varmekablene krever mye energi og kan også representere en eksplosjonsfare.

Den foreliggende oppfinnelse er kjennetegnet ved at den omfatter isolasjonsmidler for å styre varmeoverføringen fra oppvarmingsmidlene inn mot produksjonsrør/injeksjonsrøret.

Fremgangsmåten for å tilføre varme til produksjons-/injeksjonsrørledningen kjennetegnes ved at kjølefluid eller spillfluid fra en prosess på en installasjon føres i transportkanaler langs et produksjonsrør/injeksjonsrør.

Oppvarmingsmidlene består i en variant av oppfinnelsen av et rør eller en slange for transport av oppvarmingsfluid. Røret eller slangen kan være viklet rundt rørledningen og eventuelt ligge i det samme isolasjonssjiktet som kontrollkablene. Oppvarmingsfluidet kan for eksempel være kjølevæske eller spillvann som benyttes for å kjøle ned motorer og annet utstyr om bord på en plattform eller et skip. Dette vannet kan føres inn i varmerøret eller slangen og bidra til å holde temperaturen på oljen eller gassen oppe. Selv om kjølevæsken ikke skulle holde en temperatur på 50 - 100°C vil den likevel kunne benyttes for oppvarming av produksjons-/injeksjonsrørledningen og sørge for at isolasjonssjiktet ikke kjøles ned av det kalde omkringliggende sjøvannet.

I en annen variant av den foreliggende oppfinnelse består midlene i en elektrisk varmekabel eller en elektrisk induksjonskabel.

I en foretrukket utførelsesform av den foreliggende oppfinnelse omfatter isolasjonssjiktet indre og/eller ytre kanalelementer plassert rundt produksjons-/injeksjonsrørledningen, i hvilke kanalelementers kanaler de rundt produksjons-/injeksjonsrørledningen viklede kablene er plassert. Kanalelementene kan også vikles kontinuerlig rundt produksjons-/injeksjonsrørledningen på samme måte som kablene.

Viklingen av kablene og/eller kanalelementene kan skje enten i spiralform eller være en såkalt Z-vikling. Imidlertid er det fullt mulig også, i enkelte utførelser, å rette kanalelementene parallelt med røret uten vikling.

I en ytterligere variant av den foreliggende oppfinnelse er det utformet transportkanaler for varmefluid direkte i kanalelementene.

For å beskytte produksjons-/injeksjonsrøret og eventuelle andre utvendige rør, kan disse belegges utvendig med et korrosjonshindrende belegg eller ha en øket veggtykkelse i form av et korrosjonstillegg.

Fremgangsmåten for fremstilling av produksjons- /injeksjonsrørledningen kjennetegnes ved at rørledningen fremstilles i en kontinuerlig produksjonslinje der rørene, kablene, isolasjonsmidler og kanalelementene legges rundt kjerneelementet, at indre kanalelementer først legges rundt kjerneelementet, at rør og eller kabler deretter legges i langsgående kanaler i kanalelementene, at ytre kanalelementer med langsgående kanaler deretter legges fluktende med de indre kanalelementenes kanaler slik at rørene og/eller kablene omsluttes av kanalelementer, og at isolasjonsmidlene legges enten som separate elementer eller utgjøres av minst en del av kanalelementene.

Oppfinnelsen skal beskrives nærmere i det etterfølgende ved hjelp av utførelseseksempler under henvisning til de medfølgende figurer, der:

Figur 1 viser et tverrsnitt gjennom en produksjonsrørledning ifølge oppfinnelsen i en første utførelsesform,

Figur 2 viser et tverrsnitt gjennom en produksjonsrørledning ifølge oppfinnelsen i en andre utførelsesform,

Figur 3 viser et tverrsnitt gjennom en produksjonsrørledning ifølge oppfinnelsen i en andre utførelsesform,

Figur 4 viser et blokkdiagram som illustrerer en fremgangsmåte for fremstilling av en produksjons- /injeksjonsrørledning og

Figur 5 viser et fabrikkasjonsanlegg for fremstilling av en rørledning.

I en første utførelsesform vist i figur 1 omfatter produksjonsrørledningen et produksjonsrør 1 med en sentralt gjennomgående boring 2 for transport av et produksjonsfluid. På utsiden av produksjonsrøret 1 er det viklet kontrollkabler 3 og varmerør 4. I figuren er det vist fem elektriske kontrollkabler, fem kontrollkabler for kontrollfluid (for eksempel hydraulikkolje) og fem varmerør, men antallet av slike og forholdet mellom disse kan selvsagt varieres etter behov.

Et antall indre kanalelementer 5 er anordnet rundt produksjonsrøret 1. I de indre kanaleelementene 5 er det utformet kanaler 6, som kontrollkablene og varmerørene kan plasseres i. Ytre kanalelementer 7 er anordnet utenfor de indre kanalelementene 5. De ytre kanaleelementene 7 er også utstyrt med kanaler 8, som respektivt sammen med en kanale 6 danner et lukket tverrsnitt, i hvilket en kontrollkabel 3 eller et varmerør 4 er plassert. Utenfor de ytre kanaleelementene 7 er det anordnet en ytre omhylning 9 som tjener til å holde kanalelementene 5 og 7 på plass, samt gi en beskyttelse mot sjøvannet.

Kanalelementene 5 og 7 er fortrinnsvis av plast, for eksempel PVC-skum, som har gode termiske isolasjonsegenskaper. Samtidig har kanalelementene 5, 7 en viss slagfasthet og tjener derfor til å beskytte kontrollkablene og produksjonsrøret mot påkjenninger. Kontrollkablene og varmerørene ligger med et visst spillerom inne i kanalelementene 5 og 7 og kan derved bevege seg noe i forhold til hverandre og i forhold til produksjonsrøret 1. Kanalelementene 5, 7 kan være utformet slik at de har en lavere varmeovergangskoeffisient på den siden som vender mot produksjonsrøret 1, for

eksempel ved at de indre kanalelementene 5 er tynnere eller består av et materiale med bedre varmeledningsegenskaper.

Varmerørene/slangene kan være utformet som rør for transport av et oppvarmingsfluid, for eksempel vann, olje eller gass. Fortrinnsvis benyttes kjølevæske fra prosesser om bord i en plattform eller et produksjonsskip til oppvarming av produksjonsrørledningen.

En andre utførlsesform ifølge oppfinnelsen er vist i figur 2. Her er det også anordnet et sentralt produksjonsrør 10. Rundt produksjonsrøret 1 er det anordnet et lag 11 av et materiale med god termisk ledeevne. Utenfor det ledende laget 11 er det anordnet indre profilelementer eller kanalelementer 12. Disse elementene 12 er laget av et materiale med god termisk isolasjonsevne, for eksempel PVC-skum eller massiv PVC. Sammen med ytre profilelementer eller kanalelementer 13, som også er laget av et materiale med god termisk isolasjonsevne, definerer de indre kanalelementene 12 kanaler 14, 15, 16 og 17. I kanalene 14 er det anordnet varmerør 18, som står i god termisk kontakt med det ledende laget 11. Fortrinnsvis er det utformet utsparinger 19 i det ledende laget 11 tilpasset varmerørenes 18 omkrets.

I kanalene 15 er det anordnet fluidrør 20 for overføring av for eksempel hydraulikkolje. I kanalene 16 er det anordnet elektriske signalkabler 21 eller fluidrør 22. I kanalene 17 er det anordnet elektriske kraftkabler 23, fortrinnsvis for overføring av høy spenning.

Utenfor kanalelementene 13 er det anordnet et reflekterende lag 24, som er innrettet til å reflektere varmestråling inn mot produksjonsrøret 10. Helt ytterst er det anordnet en ytre omhylning 25, som har til hensikt å holde komponentene innenfor på plass og beskytte disse mot ytre påkjenninger, slik som sjøvann og støt/slag.

Alternativt til eller i tillegg til varmerørene 18 kan det være utformet varmekanaler 26 i de indre kanalelementene 12. Disse varmekanalene kan godt ha et halvsirkelformet tverrsnitt, slik at de oppviser en stor overflate mote det ledende laget 11. Kanalene 26 er innrettet til å føre et varmetransportfluid, for eksempel spillvann fra en prosess på en installasjon. De kan godt være helt lekkasjetette, men en moderat lekkasje kan godt tolereres.

Det ledende laget kan også være av et materiale som gir katodisk beskyttelse for produksjonsrøret. Laget trenger ikke å omslutte produksjonsrøret fullstendig, men bestå av et antall segmenter.

I en tredje utførelsesform, vist i figur 3, omfatter produksjons-/injeksjonsrørledningen et produksjonsrør 30. Utenfor dette er det anordnet en varmekappe 31, hvori det er utformet et antall varmekanaler 32. Varmekappen er laget av et materiale med god termisk ledeevne. Utenfor varmekappen 31 er det anordnet indre profilelementer eller kanalelementer 32. Disse elementene 32 er laget av et materiale med god termisk isolasjonsevne, for eksempel PVC-skum eller massiv PVC. Sammen med ytre profilelementer eller kanalelementer 33, som også er laget av et materiale med god termisk isolasjonsevne, definerer de indre kanalelementene 32 kanaler 34, 35, 36 og 37. I kanalene 34 kan det være anordnet varmerør 38, som virker i tillegg til varmekappen 31. Alternativt kan varmekappen fungere alene som oppvarmingsanordning.

I kanalene 35 er det anordnet fluidrør 40 for overføring av for eksempel hydraulikkolje. I kanalene 36 er det anordnet elektriske signalkabler 41 eller fluidrør 42. I kanalene 37 er det anordnet elektriske kraftkabler 43, fortrinnsvis for overføring av høy spenning.

Utenfor kanalelementene 33 er det anordnet et reflekterende lag 44, som er innrettet til å reflektere varmestråling inn mot produksjonsrøret 30. Helt ytterst er det anordnet en ytre omhylning 45, som har til hensikt å holde komponentene innenfor på plass og beskytte disse mot ytre påkjenninger, slik som sjøvann og støt/slag.

Varmekappen kan være fremstilt av et materiale som gir katodisk beskyttelse for produksjonsrøret. Laget trenger ikke å omslutte produksjonsrøret fullstendig, men bestå av et antall segmenter.

I stedet for varmerør som transporterer varmefluid, kan det også benyttes elektriske varmekabler eller elektriske ledere som overfører varme ved hjelp av induksjon. I sistnevnte tilfelle kan det ledende laget 11 eller varmekappen 31 være laget av et materiale som lett lar seg oppvarme ved induksjon fra utenforliggende elektriske ledere. Eventuelt kan tapsenergi fra elektriske høyspenningsledere 23, 43 anvendes for induksjon av varme i det ledende laget 11 eller varmekappen 31.

Det kan være anordnet temperaturfølere kontinuerlig langsetter produksjons-/injeksjonsrørledningen eller på bestemte steder, for å overvåke temperaturen på varmefluidet og/eller produksjonsrørstrømmen. Overvåkningen kan være enten kontinuerlig eller intermittisk. Temperaturfølerne kan sende signaler til en installasjon enten via egne ledninger eller via en av de øvrige elektriske kabler.

Temperaturfølerne er fortrinnsvis av fiberoptisk type. Et eksempel på slike optiske temperaturfølere er slike som er utviklet av I.D. FOS Research. Dette er fiberoptiske sensorer som baserer seg på såkalte Bragg gittere. Dette er et gitter som omfatter et filter som slipper igjennom bestemte bølgelengder og et speil som reflekterer lys med bestemte bølgelengder. Utgangsavstanden mellom filteret og speilet er kjent. En temperaturendring vil medføre at avstanden mellom filteret og speilet endres. denne endringen av avstanden vil i sin tur medføre en endring av bølgelengden, som kan detekteres. Ved å plassere gittere som slipper igjennom og reflekterer lys av ulik bølgelengde på ulike steder i den optiske fiberen, kan temperaturen måles på disse stedene. Med dagens teknologi kan 30 målepunkter innlemmes i en og samme fiber, fordelt over en avstand på 2 km.

Ved å anordne sensoren i ulike typer fiksturer og tilordne denne ulike ytterligere komponenter, kan samme type teknologi også benyttes for å måle strekk, trykk og andre parametere som kan være viktige for produksjons-/injeksjonsrørledningen, for eksempel for å overvåke mot lekkasjer eller skader.

I og med at de optiske fiberne er svært tynne, og sensorene ikke har så svært mye større diameter enn selve fiberen, er det svært enkelt å innlemme disse i produksjons-/injeksjonsrørledningen og sensorene kan derfor plasseres på eller tett inntil det stedet hvor det er mest ønskelig å foreta målingen.

Fiber optiske sensorer er upåvirket av for eksempel nærliggende elektriske ledere og vil derfor gi pålitelige målinger under ekstreme forhold.

Kanalelementene 12, 13, 22, 23 og rørene/kablene er hensiktsmessig viklet rundt produksjonsrøret i en vikleprosess lignende den som er beskrevet i norsk patent 174940 av samme søker.

En fremgangsmåte for å fremstille produksjons-/injeksjonsrørledningen skal nå beskrives under henvisning til figurene 4 og 5.

I figur 4 er det vist et blokkdiagram som illustrerer fremgangsmåtens trinn. Ved 50 tilveiebringes det på forhånd fremstilte isolasjonsmateriale, som for eksempel kan foreligge i store lengder på rull. Ved 51 tilveiebringes prefabrikkerte rør, som også kan foreligge i store lengder på rull, der én rull tilveiebringes for hvert rør som skal anordnes i rørledningen. Ved 52 tilveiebringes de ulike kablene og andre ledere, som også foreligger i store lengder på rull og én rull for hver kabel, etc.

Ved 53 slås isolasjonsmaterialet, rørene, kablene etc. rundt senterrøret i en kontinuerlig prosess, som skal forklares nærmere under henvisning til figur 5.

Ved 54 påføres den ytre omhylningen, ved 55 spoles rørledningen opp for langring i stor lengde og ved 56 transporteres rørledningen til et transportfartøy for installasjon.

Figur 5 viser et fabrikkasjonsanlegg for kontinuerlig fremstilling av en rørledning i trinn 53 ifølge figur 4. Anlegget omfatter et antall stasjoner, vist stasjon I – VII, der antallet stasjoner er avhengig av hvor mange lag eller elementer rørledningen som skal fremstilles består av.

Et kjerneelement 105, som kan være injeksjons-/produksjonsrøret 10, 30, eventuelt utstyrt med et ledende lag 11 eller en varmekappe 31, trekkes i rett linje inn i anlegget ved hjelp av en trekkanordning 115 i stasjon I.

I stasjon II er det vist en dreieskive 121, som er dreibar om en akse 122 sammenfallende med kjerneelementets 115 senterakse. På dreieskiven 121 er det montert et antall spoler 103, som er dreibare om sine lengdeakser 114. Hver spole 103 kan være utstyrt med en brems, dersom det er behov for dette. Spolene 103 inneholder oppkveilede indre kanalelementer 5, 32. Kanalelementene 5, 32 legges på kjerneelementet inntil hverandre i helisk konfigurasjon. En traktanordning 130 sørger for riktig pålegging av kjerneelementene.

I stasjon III er det anordnet en dreieskive 122, som er tilsvarende dreieskiven 121, men der spolene 104 inneholder rør, kabler etc. som skal anordnes rundt kjerneelementet.

Hver av spolene 104 er anordnet dreibare på dreieskiven, slik at spolenes 104 rotasjonsakser alltid holdes i samme retning, slik at ikke rørene og kablene vris om sine egne akser.

Stasjon IV er i bunn og grunn lik stasjon III, men inneholder ytterligere rør og kabler opptatt på spoler 104 på en dreieskive 122. Det har ingen betydning i og for seg om det er opptatt rør eller kabler på spoler 103 i stasjon II i tillegg til kanalelementer, eller hvilke rør eller kabler som er opptatt på spoler 104 i stasjon III eller IV. Hvor mange stasjoner som behøves er avhengig av hvor mange rør eller kabler som skal legges inn i rørledningen.

I stasjon V er det anordnet en lineær trekkinnretning 116, for eksempel en lineærvinsj, som trekker i rørene, kablene og de indre kanalelementene, slik at disse trekkes av sine respektive spoler. En traktanordning 125 etter hver av stasjonene III og IV sørger for riktig pålegging av rørene og kablene i de indre kanalelementenes 5, 32 kanaler 6, 34, 35, 36, 37

I stasjon VI er det anordnet en dreieskive 110 med spoler 113 for ytre kanalelementer 7, 33. Disse kanalelementene legges utenpå rørene og kablene på en måte som gjør at de ytre kanalelementene blir liggende på motsatt side av rørene og kablene i forhold til de indre kanalelementene. En traktanordning 131 sørger for at de ytre kanalelementene legges riktig på. For øvrig fungerer stasjon VI på samme måte som stasjon II.

I stasjon VII vikles et bånd og/eller en ytre omhylning rundt rørledningen.

Ved den ovenfornevnte fremgangsmåten kan det fremstilles komplette injeksjons- og/eller produksjonsrørledninger i en kontinuerlig lengde som langt overskrider det som hittil har vært gjort. Inntil nå har det ikke vært mulig å fremstille rørlengder med en diameter større enn ca. 3'' i kontinuerlige lengder. Med den beskrevne fremgangsmåten er det mulig å fremstille rørledninger med senterrør opp til 15''.

Det sentrale røret bør være fremstilt av et materiale som tillater en kalddeformasjon på minimum 5 - 15%, slik at rørledningen kan kveiles opp en eller flere ganger på store spoler.

P a t e n t k r a v

1.
Anordning ved produksjons-/injeksjonsrørledning, omfattende et produksjonsrør/injeksjonsrør (1, 11, 31) og oppvarmingsmidler (4, 18, 26, 32) for aktiv oppvarming av røret (1, 11, 31), k a r a k t e r i s e r t v e d at den også omfatter langs produksjons-/injeksjonsrørledningen over minst 100 m kontinuerlige isolasjonsmidler (11, 12, 13, 32, 33) for å styre varmeoverføringen fra oppvarmingsmidlene (4, 18, 26, 32) inn mot produksjonsrør/injeksjonsrøret (1, 11, 31).

2.
Anordning ifølge krav 1, k a r a k t e r i s e r t v e d at produksjons-/injeksjonsrørledningen også omfatter varmeledemidler (24, 31, 44).

3.
Anordning ifølge krav 1 eller 2, k a r a k t e r i s e r t v e d at oppvarmingsmidlene omfatter et eller flere varmerør/slanger (4, 18, 26, 32) for transport av et varmefluid.

4.
Anordning ifølge krav 1, k a r a k t e r i s e r t v e d at oppvarmingsmidlene omfatter en eller flere elektriske varmekabler eller elektriske induksjonskabler.

5.
Anordning ifølge et hvilket som helst av de foregående krav, k a r a k t e r i s e r t v e d at varmeledemidlene (24, 31, 44) omfatter et termisk ledende lag (11, 31) anordnet mellom oppvarmingsmidlene (4, 18, 26, 32) og produksjonsrøret/injeksjonsrøret (1, 11, 31).

6.
Anordning ifølge krav 5, k a r a k t e r i s e r t v e d at det er utformet utsparinger (19) i det ledende laget (11), hvilke utsparinger er tilpasset oppvarmingsmiddelets (18) omkrets.

7.
Anordning ifølge et hvilket som helst av de foregående krav, k a r a k t e r i s e r t v e d at isolasjonsmidlene omfatter et termisk isolasjonslag, fortrinnsvis omfattende kanalelementer (5, 7, 12, 13, 31, 32), hovedsakelig anordnet utenfor oppvarmingsmidlene (4, 18, 26, 32).

8.
Anordning ifølge krav 6, k a r a k t e r i s e r t v e d at varmeledemidlene omfatter en eller flere kanaler (26), for transport av varmefluid, utformet i isolasjonslaget, hvilke kanaler (26) står i termisk kontakt med produksjonsrøret/injeksjonsrøret (1, 11, 31).

9.
Anordning ifølge et hvilket som helst av de foregående krav, k a r a k t e r i s e r t v e d at varmeledemidlene omfatter et termisk reflekterende lag (24, 44) anordnet utenfor oppvarmingsmidlene (4, 18, 26, 32).

10.
Anordning ifølge et hvilket som helst av de foregående krav, k a r a k t e r i s e r t v e d at oppvarmingsmidlene omfatter en varmekappe (31) hvori det er utformet varmefluidkanaler (32), hvilken kappe (31) står i termisk kontakt med produksjonsrøret/injeksjonsrøret (1, 11, 31).

11.
Anordning ifølge et hvilket som helst av kravene 5 – 10, k a r a k t e r i s e r t v e d at det termisk ledende laget (11, 31) er fremstilt av et materiale som gir katodisk beskyttelse for produksjonsrøret/injeksjonsrøret (1, 11, 31).

12.
Anordning ifølge et hvilket som helst av de foregående krav, k a r a k - t e r i s e r t v e d at det er anordnet en kontinuerlig eller intermittisk temperaturføler langs produksjonsrøret/injeksjonsrøret (1, 11, 31).

13.
Anordning ifølge et hvilket som helst av de foregående krav, k a r a k - t e r i s e r t v e d at det er anordnet en kontinuerlig eller intermittisk trykk-, strekk- og/eller lekkasjeføler langs produksjonsrøret/injeksjonsrøret (1, 11, 31).

14.
Anordning ifølge krav 12, k a r a k t e r i s e r t v e d at føleren er en optisk sensor, fortrinnsvis av Bragg-typen.

15.
Fremgangsmåte for å tilføre varme til en produksjons-/injeksjonsrørledning, k a r a k t e r i s e r t v e d at kjølefluid eller spillfluid fra en prosess på en installasjon føres i transportkanaler (4, 18, 26, 32) langs et produksjonsrør/injeksjonsrør (1, 11, 31).

16.
Fremgangsmåte ifølge krav 15, k a r a k t e r i s e r t v e d at kjølefluidet er spillvann.

17.
Fremgangsmåte for å fremstille produksjons-/injeksjonsrørledning, omfattende et produksjonsrør/injeksjonsrør (1, 11, 31) omfattende flere langstrakte elementer, innbefattende et kjernerør, som skal tjene som injeksjon-/produksjonsrør, rør og/eller kabler anordnet utenfor kjerneelementet og kanalelementer med kanaler i hvilke rørene og/eller kablene er fritt bevegelige, samt en beskyttende ytre omhylning, k a r a k t e r i s e r t v e d at rørledningen fremstilles i en kontinuerlig produksjonslinje der rørene, kablene, isolasjonsmidler og kanalelementene legges rundt kjerneelementet, at indre kanalelementer først legges rundt kjerneelementet, at rør og eller kabler deretter legges i langsgående kanaler i kanalelementene, at ytre kanalelementer med langsgående kanaler deretter legges fluktende med de indre kanalelementenes kanaler slik at rørene og/eller kablene omsluttes av kanalelementer, og at isolasjonsmidlene legges enten som separate elementer eller utgjøres av minst en del av kanalelementene..

18.

Fremgangsmåte ifølge krav 17, k a r a k t e r i s e r t v e d at isolasjons- og varmeledemidler (11, 12, 13, 24, 31, 32, 33, 44) vikles i spiral rundt kjerneelementet.

19.

Fremgangsmåte ifølge krav 17 og 18, k a r a k t e r i s e r t v e d at injeksjons- og/eller produksjonsrørledningen spoles opp på en eller flere spoler med stor diameter.